TOPIC
Mathematical Connections and Problem Solving

KEY QUESTION
How do you develop a ranking system to determine which airlines are more likely to arrive on time when the information you have is number of minutes late for five airlines departing from Minneapolis-St. Paul (MSP) International Airport?

LEARNING GOALS
Students will:
• Use numeric data to create a ranking system
• Consider how to use data
• Make decisions about whether or not a solution meets the needs of a client
• Communicate the solution clearly to the client

GUIDING DOCUMENTS
This activity has the potential to address many mathematics standards. Please see pages 4-7 for a complete list of mathematics and science standards.

RECOMMENDED SUPPLIES FOR ALL MODEL-ELICITING ACTIVITIES
It is recommended to have all of these supplies in a central location in the room. It is recommended to let the students know that they are available, but not to encourage them to use anything in particular.

• Overhead transparencies and transparency markers/pens, whiteboards and markers, posterboards, or other presentation tools such as a document camera.
• Calculators
• Rulers, scissors, tape
• Markers, colored pencils, pencils
• Construction paper, graph paper, lined paper
• Paper towels or tissues (for cleaning transparencies)
• Manila folders or paper clips for collecting the students’ work
• Optional: Computers with programs such as Microsoft Word and Excel

WHAT ARE MODEL-ELICITING ACTIVITIES (MEAs)?
Model-Eliciting Activities are problem activities explicitly designed to help students develop conceptual foundations for deeper and higher order ideas in mathematics, science, engineering, and other disciplines. Each task asks students to mathematically interpret a complex real-world situation and requires the formation of a mathematical description, procedure, or method for the purpose of making a decision for a realistic client. Because teams of students are producing a description, procedure, or method (instead of a one-word or one-number answer), students’ solutions to the task reveal explicitly how they are thinking about the given situation.

THE ON TIME ARRIVAL MEA CONSISTS OF FOUR COMPONENTS:
1) Newspaper article: Students individually read the newspaper article to become familiar with the context of the problem. This handout is on page 8.
2) Readiness questions: Students individually answer these reading comprehension questions about the newspaper article to become even more familiar with the context and beginning thinking about the problem. This handout is on page 9.
3) Problem statement: In teams of three or four, students work on the problem statement for 45 – 90 minutes. This time range depends on the amount of self-reflection and revision you want the students to do. It can be shorter if you are looking for students’ first thoughts, and can be longer if you expect a polished solution and well-written letter. The handouts are on pages 10-11. Each team needs the handouts on pages 10-11.
4) Process of sharing solutions: Each team writes their solution in a letter or memo to the
client. Then, each team presents their solution to the class. Whole class discussion is intermingled with these presentations to discuss the different solutions, the mathematics involved, and the effectiveness of the different solutions in meeting the needs of the client. In totality, each MEA takes approximately 2-3 class periods to implement, but can be shortened by having students do the individual work during out-of-class time. The Presentation Form can be useful and is explained on page 4 and found on page 13.

RECOMMENDED PROGRESSION OF THE ON TIME ARRIVAL MEA

While other implementation options are possible for MEAs, it is recommended that the MEA be implemented in a cooperative learning format. Numerous research studies have proven cooperative learning to be effective at improving student achievement, understanding, and problem solving skills. In this method students will complete work individually (Newspaper article and readiness questions; as well as initial thoughts on the problem statement) and then work together as a group. This is important because brainstorming works best when students have individual time to think before working as a group. Students can be graded on both their individual and group contributions. Social skills’ discussion at the beginning of the MEA and reflection questions at the end of the MEA are also essential aspects of cooperative learning.

Social Skills (3 - 5 minutes)
Students must be taught how to communicate and work well in groups. Several social skills that are essential to group work are decision-making, asking questions, and communicating and listening. The teacher can show part of a YouTube video and discuss aspects of these skills before beginning the MEA.
(http://www.youtube.com/user/flowmathematics)

Newspaper Article and Readiness Questions:
The purpose of the newspaper article and the readiness questions is to introduce the students to the context of the problem.

(10 minutes): Give the article and the questions to the students the day before for homework. Then, in the next class, discuss as a class the answers to the readiness questions before beginning to discuss the problem statement.

Problem Statement:
You may want to read the problem statement to the students and then identify as a class: a) the client that the students are working for and b) the product that the students are being asked to produce. Once you have addressed the points above, allow the students to work on the problem statement. Let the students know that they will be sharing their solution to the rest of the class. Tell students that you will randomly pick a group member to present for each group. Tell the students that they need to make sure that everyone understands their group’s solution so they need to be sure to work together well. The group member who will present can be picked by assigning each group member a number.

Working on the Problem Statement (35-50 minutes): Place the students in teams of three or four. Students should begin to work by sharing their initial ideas for solving the problem. If you already use teams in your classroom, it is best if you continue with these same teams since results for MEAs are better when the students have already developed a working relationship with their team members. If you do not use teams in your classroom and classroom management is an issue, the teacher may form the teams. If classroom management is not an issue, the students may form their own teams. You may want to have the students choose a name for their team to promote unity.

Teachers’ role: As they work, your role should be one of a facilitator and observer. Avoid questions or comments that steer the students
toward a particular solution. Try to answer their questions with questions so that the student teams figure out their own issues. Also during this time, try to get a sense of how the students are solving the problem so that you can ask them questions about their solutions during their presentations.

**Presentations of Solutions** (15-30 minutes): The teams present their solutions to the class. There are several options of how you do this. Doing this electronically or assigning students to give feedback as out-of-class work can lessen the time spent on presentations. If you choose to do this in class, which offers the chance for the richest discussions, the following are recommendations for implementation. Each presentation typically takes 3 – 5 minutes. You may want to limit the number of presentations to five or six or limit the number of presentations to the number of original (or significantly different) solutions to the MEA.

Before beginning the presentations, encourage the other students to not only listen to the other teams’ presentations but also to a) **try to understand the other teams’ solutions** and b) **consider how well these other solutions meet the needs of the client**. You may want to offer points to students that ask ‘good’ questions of the other teams, or you may want students to complete a reflection page (explanation – page 4, form – page 14) in which they explain how they would revise their solution after hearing about the other solutions. As students offer their presentations and ask questions, whole class discussions should be intermixed with the presentations in order to address conflicts or differences in solutions. When the presentations are over, collect the student teams’ memos/letters, presentation overheads, and any other work you would like to look over or assess.

**ASSESSMENT OF STUDENTS’ WORK**
You can decide if you wish to evaluate the students’ work. If you decide to do so, you may find the following Assessment Guide Rubric helpful:

**Performance Level Effectiveness:** Does the solution meet the client’s needs?

**Requires redirection:** The product is on the wrong track. Working longer or harder with this approach will not work. The students may need additional feedback from the teacher.

**Requires major extensions or refinements:** The product is a good start toward meeting the client’s needs, but a lot more work is needed to respond to all of the issues.

**Requires editing and revisions:** The product is on a good track to be used. It still needs modifications, additions or refinements.

**Useful for this specific data given, but not shareable and reusable OR Almost shareable and reusable but requires minor revisions:** No changes will be needed to meet the immediate needs of the client for this set of data, but not generalized OR Small changes needed to meet the generalized needs of the client.

**Share-able or re-usable:** The tool not only works for the immediate solution, but it would be easy for others to modify and use in similar situations. OR The solution goes above and beyond meeting the immediate needs of the client.
IMPLEMENTING AN MEA WITH STUDENTS FOR THE FIRST TIME
You may want to let students know the following about MEAs:
• MEAs are longer problems; there are no immediate answers. Instead, students should expect to work on the problem and gradually revise their solution over a period of 45 minutes to an hour.
• MEAs often have more than one solution or one way of thinking about the problem.
• Let the students know ahead of time that they will be presenting their solutions to the class. Tell them to prepare for a 3-5 minute presentation, and that they may use overhead transparencies or other visuals during their presentation.
• Let the students know that you won’t be answering questions such as “Is this the right way to do it?” or “Are we done yet?” You can tell them that you will answer clarification questions, but that you will not guide them through the MEA.
• Remind students to make sure that they have returned to the problem statement to verify that they have fully answered the question.
• If students struggle with writing the letter, encourage them to read the letter out loud to each other. This usually helps them identify omissions and errors.

OBSERVING STUDENTS AS THEY WORK ON THE ON TIME ARRIVAL MEA
You may find the Observation Form (page 12) useful for making notes about one or more of your teams of students as they work on the MEA. We have found that the form could be filled out “real-time” as you observe the students working or sometime shortly after you observe the students. The form can be used to record observations about what concepts the students are using, how they are interacting as a team, how they are organizing the data, what tools they use, what revisions to their solutions they may make, and any other miscellaneous comments.

PRESENTATION FORM (Optional)
As the teams of students present their solutions to the class, you may find it helpful to have each student complete the presentation form on page 11. This form asks students to evaluate and provide feedback about the solutions of at least two teams. It also asks students to consider how they would revise their own solution to the On Time Arrival MEA after hearing of the other teams’ solutions.

STUDENT REFLECTION FORM
You may find the Student Reflection Form (page 14) useful for concluding the MEA with the students. The form is a debriefing tool, and it asks students to consider the concepts that they used in solving the MEA and to consider how they would revise their previous solution after hearing of all the different solutions presented by the various teams. Students typically fill out this form after the team presentations.

STANDARDS ADDRESSED
NCTM MATHEMATICS STANDARDS
Numbers and Operations:
• Work flexibly with fractions, decimals, and percents to solve problems
• Understand and use ratios and proportions to represent quantitative relationships
• Understand the meaning and effects of arithmetic operations with fractions, decimals, and integers
• Develop and analyze algorithms for computing with fractions, decimals, and integers and develop fluency in their use
• Judge the reasonableness of numerical computations and their results
Algebra
• Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules
• Relate and compare different forms of representation for a relationship
• Model and solve contextualized problems using various representations, such as graphs, tables, and equations
• Use symbolic algebra to represent and explain mathematical relationships
• Identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationships
• Draw reasonable conclusions about a situation being modeled

**Measurement**
• Analyze precision, accuracy, and approximate error in measurement situations

**Data Analysis and Probability**
• Find, use, and interpret measures of center and spread, including mean and interquartile range
• Select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatter plots

**Problem Solving**
• Build new mathematical knowledge through problem solving
• Solve problems that arise in mathematics and in other contexts
• Apply and adapt a variety of appropriate strategies to solve problems
• Monitor and reflect on the process of mathematical problem solving

**Reasoning and Proof**
• Develop and evaluate mathematical arguments and proofs
• Make and investigate mathematical arguments and proofs

**Communication**
• Organize and consolidate their mathematical thinking through communication
• Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
• Analyze and evaluate the mathematical thinking and strategies of others
• Use the language of mathematics to express mathematical ideas precisely

**Connections**
• Recognize and use connections among mathematical ideas
• Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
• Recognize and apply mathematics in contexts outside of mathematics

**Representation**
• Use representations to model and interpret physical, social, and mathematical phenomena

---

**NRC Science Standards**

**Inquiry**
• Use appropriate tools and techniques to gather, analyze and interpret data
• Develop descriptions, explanations, predictions, and models using evidence
• Think critically and logically to make the relationships between evidence and explanations
• Recognize and analyze alternative explanations and predictions
• Communicate scientific procedures and explanations
• Use mathematics in all aspects of scientific inquiry

**Common Core Math Standards**
• 5 MD-2: represent and interpret data
• 6 SP-1 Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.
• 6 SP-2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
• 6 SP-3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
• 6 SP-4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
• 6 SP-5 Summarize numerical data sets in relation to their context, such as by:
  a. Reporting the number of observations.
  b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
  c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the
context in which the data were gathered.

d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

• 7 EE Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.

• 7.RP Analyze proportional relationships and use them to solve real-world and mathematical problems.

1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.

2. Recognize and represent proportional relationships between quantities.

a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

c. Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.

d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.

3. Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

8.EE Understand the connections between proportional relationships, lines, and linear equations.

5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

• High School S-ID Summarize, represent, and interpret data on a single count or measurement variable.

2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

3. Interpret differences in shape, center, and spread in the context of the data sets,
accounting for possible effects of extreme data points (outliers).

Interpret linear models

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

• S-IC Understand and evaluate random processes underlying statistical experiments
  1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population

<table>
<thead>
<tr>
<th>Mathematical Practice</th>
<th>How it occurs in MEAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Make sense of problems and persevere in solving them.</td>
<td>As participants work through iterations of their models they continue to gain new insights into ways to use mathematics to develop their models. The structure of MEAs allows for participants to stay engaged and to have sustained problem solving experiences.</td>
</tr>
<tr>
<td>2. Reason abstractly and quantitatively</td>
<td>MEAs allow participants to both contextualize, by focusing on the real world context of the situation, and decontextualize by representing a situation symbolically.</td>
</tr>
<tr>
<td>3. Construct viable arguments and critique the reasoning of others.</td>
<td>Throughout MEAs while groups are working and presenting their models.</td>
</tr>
<tr>
<td>4. Model with mathematics.</td>
<td>This is the essential focus of MEAs; for participants to apply the mathematics that they know to solve problems in everyday life, society, or the workplace. This is done through iterative cycles of model construction, evaluation, and revision.</td>
</tr>
<tr>
<td>5. Use appropriate tools strategically.</td>
<td>Materials are made available for groups as they work on MEAs including graph paper, graphing calculators, computers, applets, dynamic software, spreadsheets, and measuring devices.</td>
</tr>
<tr>
<td>6. Attend to precision.</td>
<td>Precise communication is essential in MEAs and participants develop the ability to communicate their mathematical understanding through different representations including written, verbal, symbolic, graphical, pictorial, concrete, and realistic.</td>
</tr>
<tr>
<td>7. Look for and make use of structure.</td>
<td>Participants in MEAs can use their knowledge of mathematical properties and algebraic expressions to develop their solutions.</td>
</tr>
<tr>
<td>8. Look for and express regularity in repeated reasoning.</td>
<td>As participants develop their models the patterns they notice can assist in their model development.</td>
</tr>
</tbody>
</table>
NEWSPAPER ARTICLE: THE CHALLENGES OF FLYING

St. Paul, Minnesota - With 180,000 people flying in and out of Minneapolis-St. Paul (MSP) International Airport in St. Paul each day, nearly 70 million people per year, MSP is one of the busiest airports in the world. Being this busy has advantages for passengers. For instance, if one’s flight gets cancelled, one has a very good chance of finding another flight. Also, MSP has flights to virtually every other airport in the world.

However, along with these advantages come some disadvantages for the passengers. It can be difficult to get to one’s gate, to park one’s car, to pick up one’s baggage, and to check in when you have to compete with thousands of other people each day. Despite these disadvantages, people keep coming back to the airport and passengers have even rated the airport as their favorite airport in the world (on an internet survey). On the survey, passengers provided numerous reasons for their like of MSP airport. A popular reason was that all of the airlines at MSP try to stay on schedule. Staying on schedule is very important, because one or two little disturbances can offset the entire airport schedule.

Travelers typically have three main concerns when flying to their destination. First and foremost, they are concerned with safety. When asked, most passengers say that they would not mind being a few minutes late to ensure that they arrive at their destination safely and without incident. After safety, the passengers’ second most common concern is whether the flight takes off and arrives on time. Third, they want their baggage to be shipped to the correct destination and to also arrive on time.

MSP does a fantastic job of making sure the planes arrive and leave on time; however, many things can impact this timing. Those that travel regularly can make a pretty calculated guess as to whether their flights will arrive on time. This timing is contingent on several factors.

First, the origin of the flight impacts the plane’s chance of arriving on-time. For example, planes rarely leave late from San Diego, California due to San Diego’s great weather, but they frequently leave San Francisco late due to weather conditions such as fog. Veteran travelers often try to avoid flights that leave San Francisco to come to MSP. Second, the on-time arrival is based on the flight’s destination. For example, sometimes a destination takes a plane into a very busy airport that may be too small for the amount of daily air traffic. In this case, a gate may not always be ready for the plane to pull up to and unload the passengers. Thus, the plane will have to wait. Similarly, an understaffed maintenance department may impact the company’s ability to fix planes on a timely basis. Third, the on-time arrival may be dependent on the company. Some airlines are known for being consistently on-time, while other airlines are known for not being on-time.

For some travelers, arriving on-time is not an issue, because they are not in a hurry. For example, a family flying from Pittsburgh to Orlando in order to visit Disney World may not be too concerned if they arrive 15 to 30 minutes late. However, business travelers may miss important meetings if their flights arrive late.
Readiness Questions

1. Where is one of the busiest airports in the world?

2. What do you believe might be another busy airport?

3. Why would arriving on time be important to some travelers and not as important to other travelers?

4. List one thing cited in the article that may cause a plane to be late.

5. Can you think of other reasons for a plane to be late that are not mentioned in the article?
**PROBLEM STATEMENT**

<table>
<thead>
<tr>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>In June, Maplewood Middle School’s Spanish club is going on a study abroad trip to Venezuela, and they have hired your class to help them select which airline to fly. Last year the Spanish club had a miserable experience when traveling to Barcelona. Their connecting flight to Reykjavik, Iceland was late, so they missed their next flight to Barcelona. The entire class had to stay overnight in the airport.</td>
</tr>
</tbody>
</table>

This year the class has decided to take a more systematic approach to choosing an airline. So far, the class has identified five airlines with economical fares that fly from Minneapolis-St. Paul (MSP) International Airport to Venezuela, but they are still in the process of identifying more airlines that fly to Venezuela. Most of the flights have a connecting flight in Mexico City. They are hoping to find the airline that has the smallest chance of departing late from MSP so that they are less likely to arrive late in Mexico City. They don’t want to miss their one connecting flight to Venezuela this year! |

In the table that follows, you will find information about departure times for flights on the five airlines that the Spanish Club has identified thus far. The departure times are for flights leaving from MSP International Airport and scheduled to arrive in Mexico City. Rank the five airlines in terms of most likely to be on time to least likely to be on time for departing from MSP Airport. As you rank the airlines, keep track of your process. Describe your process in a letter to the Spanish Club so that they may use a similar process to rank the additional airlines that they may identify at a later time.
## Number of Minutes Late for Flights Departing from MSP Airport

<table>
<thead>
<tr>
<th>Sky Voyage Airline</th>
<th>Central American Airlines</th>
<th>Mexico Express</th>
<th>Sudamerica Internacional</th>
<th>Southeast Airline</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>15</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>9</td>
<td>5</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>5</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>125</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>20</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>0</td>
<td>15</td>
<td>10</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
<td>0</td>
<td>35</td>
<td>10</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>9</td>
<td>55</td>
<td>10</td>
</tr>
<tr>
<td>40</td>
<td>25</td>
<td>7</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>12</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>0</td>
<td>20</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>15</td>
<td>0</td>
<td>17</td>
<td>27</td>
</tr>
<tr>
<td>0</td>
<td>11</td>
<td>10</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>0</td>
<td>12</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>13</td>
<td>65</td>
<td>30</td>
</tr>
<tr>
<td>60</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>30</td>
<td>10</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
<td>6</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>123</td>
<td>10</td>
<td>5</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>25</td>
<td>7</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>
OBSERVATION FORM FOR THE TEACHER - On Time Arrival MEA

Team: ________________________________

Math Concepts Used:
What mathematical concepts and skills did the students use to solve the problem?

Team Interactions:
How did the students interact within their team or share insights with each other?

Data Organization & Problem Perspective:
How did the students organize the problem data? How did the students interpret the task? What perspective did they take?

Tools:
What tools did the students use? How did they use these tools?

Miscellaneous Comments about the team functionality or the problem:

Cycles of Assessment & Justification:
How did the students question their problem-solving processes and their results? How did they justify their assumptions and results? What cycles did they go through?
PRESENTATION FORM – On Time Arrival MEA

Name_____________________________________________

While the presentations are happening, choose TWO teams to evaluate. Look for things that you like about their solution and/or things that you would change in their solution. You are not evaluating their style of presenting. For example, don't write, “They should have organized their presentation better.” Evaluate their solution only.

Team ____________________________

What I liked about their solution:

What I didn’t like about their solution:

Team ____________________________

What I liked about their solution:

What I didn’t like about their solution:

After seeing the other presentations, how would you change your solution? If you would not change your solution, give reasons why your solution does not need changes.
STUDENT REFLECTION FORM – On Time Arrival MEA

Name __________________________ Date__________________________

1. What mathematical or scientific concepts and skills (e.g. ratios, proportions, forces, etc.) did you use to solve this problem?

2. How well did you understand the concepts you used?

   Not at all  A little bit  Some  Most of it  All of it

   Explain your choice:

3. How well did your team work together? How could you improve your teamwork?

4. Did this activity change how you think about mathematics?